CLEANABLE SHIPPING CONTAINER

Field of the Invention.

The present invention relates to shipping containers and in particular to a cleanable and collapsible shipping container.

Background of the Invention.

In many industries products must be shipped in cleanable containers. Such containers may hold food products, hospital supplies, or electronic components, to name but a few examples. Each of these applications and others have their own requirements for cleanliness. The manufacture of electronic circuit components may require ultra-clean containers; surgical instruments may require shipping containers with a maximum specified germ count; containers for fruits and vegetables may have a different cleanliness standard; containers for meat products may have yet a different cleanliness requirement. All these applications have in common the need for a shipping container that can be cleaned easily.

An additional advantageous feature for shipping containers is the ability to reuse them. In many marketing contexts product is brought to a retail vendor by a middleman or distributor, and a worker employed by the distributor removes product from the container and stocks the product on the retail vendor's shelves. The worker must then either dispose of the shipping container or return it to the distributor for reuse. In this and other marketing arrangements, it is

advantageous if the container stacks or collapses for compact return shipment so that it may be replaced.

Summary of the Invention.

The present invention provides a shipping container that is readily cleanable and that can be knocked down easily for compact shipping when it is empty. To this end the container of the present invention includes a bottom, two side walls, and two end walls, all made of injection molded plastic. The walls and bottom are made of a first material, sufficiently rigid to provide structural integrity. The walls and bottom are connected to each other by hinges made of a flexible, resilient material that forms living hinges. The hinges are permanently fused to the first material without seams or crevices that could collect contaminants. The sides and bottom include structural elements that provide direct transfer of loads from one to the other. These elements can include interlocking dovetail shapes, T-shapes, and the like. Because the hinges are resilient, they may be stretched to allow the structural elements to align with each other and then snapped into place.

A groove is formed near the top of some of the walls to receive a band or strap. When the container is erected, the grooves in the walls support a band placed in the groove to hold the box erect. To knock the box down, the strap is removed.

The walls and bottom may be made by injection molding. The hinges may be injection molded in a separate step during which the hinge material and the

first material (of which the walls and bottom are made) fuse to one another. The leaves of the hinges join the surrounding material free of crevices or grooves to minimize spaces where undesirable contaminants could hide.

The bottom is formed with short hinge supporting walls along alternate edges. These short hinge supporting walls are proportioned to mount the end walls of the container above the side walls so that the side walls may be folded compactly onto the bottom, and thereafter the end walls may be folded flat on top of the side walls.

The container of the present invention is easily made rectangular with walls generally perpendicular to the bottom when erected. However, other shapes, such as hexagonal, are possible and the side walls need not be perpendicular to the bottom.

Brief Description of the Drawings.

Figure 1 is a perspective illustration looking from above showing a shipping container constructed in accordance with the present invention in an erect condition.

Figure 2 is a perspective illustration of the shipping container of Figure 1 looking from below.

Figure 3 shows the shipping container of Figure 1 in a knocked down condition and folded open.

Figure 4 is a view of the shipping container of Figure 1 in a knocked down condition folded closed.

Figure 5 shows the shipping container of Figure 4 viewed from below.

Figure 6 is an enlarged view of a portion of Figure 1 showing the corner of the shipping container and the structural elements which interlock the side walls and end walls.

Figure 7 is a view of the shipping container of Figure 1 shown partially in section and showing an end wall and a bottom wall with structural elements interlocking them.

Figure 8 is an enlarged view of the shipping container Figure 1 showing in cross-section the interlocking elements shown in Figure 7 and a hinge connecting an end wall to the bottom.

Figure 9 is a view partially in cross-section of the shipping container shown in its knocked down, folded closed condition shown in Figure 4.

Figure 10 is a view similar to Figure 9 but showing the shipping container in its knocked down, folded open condition.

Figure 11 is a view similar to Figure 10 but showing the shipping container in its erect position.

Figure 12 is plan view of a shipping container constructed according to the present invention having a hexagonal bottom, and tapered sides, shown in a knocked down condition and folded open.

Description of Preferred Embodiments.

The present invention provides a collapsible shipping container 20. Figure 1. The shipping container 20 includes a rectangular bottom 22, two side walls 24, 26 and two end walls 28, 30. The shipping container 20 includes hinges 32

(Figure 3) to connect the side walls 24, 26 and end walls 28, 30 to the bottom. The shipping container 20 has an erect condition (Figures 1 and 2) in which the side walls 24, 26 and end walls 28, 30 are generally perpendicular to the bottom and to each other to form a rectangular box. The side and end walls are held in their erect position by a flexible band 34.

The shipping container 20 has two knocked down conditions. The shipping container 20 can be knocked down by removing the flexible band 34. The band 34 typically is made of fiberglass-reinforced material or steel banding such as is readily commercially available for commercial wrapping operations. Alternatively, any flexible band, including elastic or stretchable banding, may be used. The band 34 is received in recesses 40 formed near the top edge 42 of each of the end walls 28, 30. Where the end walls 28 and 30 are made with a major, generally planar component 44 and stiffening ribs 46, the recesses 40 may simply be cut into the ribs. As an alternative to a band 34 to hold the walls 24, 26, 29 and 30 erect, a mechanical latch or hook and eye arrangement may be used. One such latch attachment is shown in US Patent 6, 131, 757 the disclosure of which is incorporated herein by reference.

When the shipping container 20 is in its erect condition, the band 34 can be placed around to prevent the walls 20 from folding outward. Although only one band 34 and one set of grooves 40 are illustrated, the side walls 24, 26, 28, 30 and end walls could be made with two or more parallel sets of grooves so that two or more bands could be used to hold the shipping container in its erect

position. Such modifications do not depart from the spirit of the present invention.

In one knocked down condition the side walls 24, 26 and end walls 28, 30 are folded outward as shown in Figure 3. This knocked down condition makes it easier for a worker to unload the shipping container. It also exposes all of the faces of the shipping container, including the hinges, for cleaning prior to reuse.

A second knockdown condition is illustrated in Figures 4 and 5. In this condition the side walls 24, 26 are folded flat against the bottom 22 and the end walls 28, 30 are folded flat on top of the side walls. This configuration may be used for return shipping an empty shipping container for cleaning and reuse.

The side walls 24, 26 and end walls 28, 30 are hinged to the bottom 22 using hinges 32 that are formed of a resilient flexible material (as discussed below). The hinges 32 therefore allow some movement of the walls 24, 26, 28, 30 relative to the bottom 32 in addition to pure rotation. For example, the side walls 24, 26 and end walls 28, 30 would be able to move up and down with respect to the bottom when in the erect position, unless restrained. As shown in Figure 3, each end wall 28, 30 is connected to the bottom 22 by three hinges 32, while each side wall 24, 26 is connected to the bottom by two hinges 32.

Figure 6 illustrates structural elements that interlock the side walls and end walls when the shipping container 20 is in the erect condition. The end wall 28 has a rectangular recess 50 formed in its vertical edge while the side wall 24 has an interfitting rectangular projection 52. The recess 50 and projection 52 have minimal clearance so that vertical loads applied to the side wall 24 are

transmitted from the projection to the end wall 28. This arrangement prevents excess vertical loads from being transmitted from the side wall 24 to the hinges 32 that mount the side wall to the bottom 22. While the projection and recess are shown as rectangular, other shapes are possible, such as dovetail shapes. As shown in Figure 3, the structural elements detailed in Figure 6 are repeated at each corner. In this way the hinges 32 between the side walls 24, 26 and the bottom 22 do not carry loads with a component normal to the faces of the recesses 50 because those loads are transferred to the end walls 28 and 30.

The recesses 50 may be completely open as shown in Figure 3. However, they may also be provided with a web 54 that spans the inside of each recess. This web limits inward folding of the side wall when the container 20 is in the erect position. Such a web 54 is shown by the dashed lines in the opening 50 in the lower left of Figure 3.

Vertical loads are transmitted from the end walls 28, 30 to the bottom 22 through interfitting T arrangements illustrated in Figures 7 - 8. Each end wall 28, 30 has two T-shaped openings 60, though only one is described in detail. A T-shaped projection 62 that interfits with the opening 60 extends upward from the bottom 22. When a vertical load (either upward or downward) is applied to the end wall 30, it is transmitted to the bottom when a face of the T-shaped opening bears on the interfitting T-shaped projection. Similarly, if a lateral force is applied to an end wall 30, that force is transmitted through the sides of the T's to the bottom 22. Although T-shapes have been illustrated, dovetails shapes or others may be used. It is only necessary that a male and female shape fit together so

that loads in plane of the wall are transmitted to the bottom through the interfitting shapes rather than through the hinges.

The side wall hinges 32 are mounted flat against the plane of the top surface of the bottom 22. This construction allows the side walls 24, 26 to be folded inward onto the bottom 22 with the inside surface of each side wall resting on top surface of the bottom, as illustrated in Figure 4.

The bottom 22 is formed to support the hinges 32 which mount the end walls 28, 30 above the plane of the top surface of the bottom wall 22 high enough that the end walls can be folded flat on top of the side walls 24, 26. Figure 4. To this end the bottom 22 includes a step 70 (Figures 3, 8-11) or short wall along its two end edges. The side wall 28 may include various ribs 72 (Figures 1, 2, 3, 4) for stiffening the side wall, and the step 70 formed in the bottom is high enough to clear these ribs. Because of the step 70, the end walls 28, 30 fold flat on top of the side walls 24, 26 as shown in Figure 4. The step 70 may extend the entire width of the bottom 22, or it may be segmented as shown in Figure 3, with a separate segment for each hinge.

The end walls 28, 30 include ribs 46 around their perimeters that serves to stiffen the end wall. Figures 1, 2, 4 and 9. The rib 46 extends out from the plane of the end wall 28 (Figure 9) along the bottom edge of the end wall far enough to protect the T-shaped projections 62 that extend upward from the bottom 22 when the end walls are folded inward. The ribs 46 include slots 48 along the bottom edge of the end walls 28, 30 wide enough to clear the T's 62 so that the end walls may be folded inward. Figures 9 and 11.

The bottom 22, end walls 28, 30, and side walls 24, 26 are made of propylene, a thermo plastic material. The side walls 24, 26 and end walls 28, 30 together with the bottom 22 are manufactured in a conventional injection molding process. Thereafter the hinges 32 are injection molded using an insert molding process. The hinges 32 are made of a flexible thermoplastic, elastomeric material. A preferred material is available under the trademark Sanoprene. In this process the previously manufactured end walls 28, 30, side walls 24, 26, and bottom 22 are inserts into the molds that form the hinges 32. The resulting hinge 32 includes an inboard leaf 80, an outboard leaf 82, and a thin connecting section 84 between them. The resulting hinge is termed a "living hinge" since it is made of a single, flexible piece of material. In contrast to mechanical hinges such as have two leaves that rotate about a hinge pin, a living hinge has no internal cavities, nooks or crannies to retain contaminants.

The side walls 24, 26 and end walls 28, 30 are made with recesses or cavities 86 (Figures 9 – 11) that partially contain the outboard leaf 82 of each hinge 32. See Figures 9 - 11. When the hinges are molded, the hot, liquid Sanoprene partially melts the bottom and side surfaces of the recess 86, forming an outboard leaf 82 of the hinge 32 that has a continuous, integral seal with the propylene of the end wall 30. This bond is free of voids, crevices, or cracks where contaminants could accumulate. In like fashion, the inboard leaf 80 of each hinge is partially melted into the propylene bottom, forming a permanent bond. Again, there are no cracks where contaminants can accumulate.

The leaves 80, 82 of each hinge 32 are joined by a slender reduced cross-section area 84. For example this web 84 may be about 1/32 of an inch thick and two or three times as wide. This slender cross-section 84, extending the length of each hinge 32, has two purposes. First, it permits free flexing so that the hinge leaves 80, 82 can rotate with respect to each other. Also this thin section stretches, allowing the fit of the T's 60, 62 between the end walls 28, 30 and the bottom 22 to have faces that are perpendicular to the plane of the bottom. When vertical loads are applied to the T's (as when the shipping containers are loaded or stacked), the loads are transmitted straight down, with little or no tendency to splay the walls from the bottom.

While particular materials have been described, other material selections are possible provided functional requirements are met. Specifically, the walls and bottom of the shipping container 20 must be of a material strong enough to maintain structural integrity while the hinges 32 are made of a material that can be flexed repeatedly without failure so that the shipping container may be reused. Also the hinge material should be slightly elastic. Finally, the two materials must have compatible melting points and chemistry so that when the hinges are molded, they fuse with the walls and bottom. As used in this application, the materials are "fused" when the two materials are so firmly integrated that they cannot be torn a part without ripping one material or the other. This may or may not reflect a chemical bond between the materials. Many combinations of polyolefins meet these criteria. In addition, polyurethanes can be used, and if properly formulated and processed, the urethanes can achieve cross-linking

between the hinge leaves and the substrate. This produces a chemical bond between the hinge leaves and the substrate.

Figure 12 illustrates schematically a number of variations that are contemplated. The container 88 of Figure 12 has a six-sided bottom 90. Three side walls 92 correspond to the side walls 24, 26 of the earlier described embodiment. The alternate walls, end walls 94, have rectangular recesses 96 in their sides and T-shaped recesses 98 in their bottoms. The rectangular recesses 96 cooperate with rectangular projections 100 on the walls 92. Resilient hinges 104, two per side, attach the sides to the bottom 90.

Several features have been changed from the first embodiment. First, the number of sides. It should be clear now that the invention can be practiced with any number of sides. With an even number of sides, alternate sides can be mounted on raised or elevated surfaces. In this case, and with walls that are not too tall, the container may have an inwardly folded position corresponding to that shown in Figures 4 and 5.

In addition, Figure 12 illustrates that the walls need not be rectangular. With trapezoidal walls as shown in Figure 12, the resulting container tapers outwardly at the top. The walls could taper in the other direction and so produce a container narrower at the top than at the bottom. Further the number of living hinges 104 and interfitting T's 98 may be varied depending on the size and intended use of the container.

With these variations, the embodiments described in connection with Figure 12 operate and are manufactured the same as the embodiments described in connection with Figures 1 – 11.

All the shipping containers constructed in accordance with the present invention have advantages over other shipping containers. The inventive shipping containers 20, 88 can be easily knocked down by slitting the packing band. The walls 24-30, 92, 94 can easily be disengaged and folded flat. (Figure 3) When folded flat, shipping containers 20, 88 constructed in accordance with the present invention stack in about one-fourth the volume of their erect state. For example, a shipping container 20 with outside dimensions of 21 inches by 18 inches and 8.5 inches high, stacks in a volume approximately 21 inches by 18 inches by about 2.125 inches high.

Moreover the shipping containers 20, 88 constructed in accordance with the present invention can readily be cleaned. The shipping containers 20, 88 can be knocked down to their opened state (Figure 3) where all surfaces are exposed for cleaning. The hinges 32, 104 have no cavities which hide contaminants. Instead all surfaces are exposed. Further, because the hinges 32 and 104 are fused to the sides and bottom, there are no seams between the hinges and the sides or bottom where contaminants can hide. As a result an ordinary commercial dishwasher or similar apparatus can be used to clean the shipping container prior to reuse.